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Owner/Applicant: Toyota Jidosha Kabushiki Kaisha

In response to the International Search Report and the Written Opinion of the International Searching Authority dated October 27, 2005 and as enclosure to the Demand for the International Preliminary Examination according to **Art. 33 PCT**, the following amended application documents according to **Art. 34 PCT** are herewith submitted:

- an amended set of **claims 1 to 13** (fair copy as well as work sheet) replacing claims 1 to 13 as presently on file, and
- amended description pages **3, 3a, 3b and 3c**, replacing page 3 as presently on file.

All further application documents are to be maintained unamended.

Moreover provision of the new documents has not to be understood so as to waive on any subject matter as originally filed.



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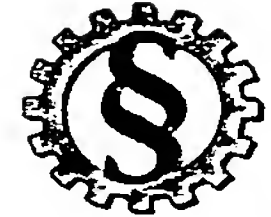
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1. Amendments and disclosure thereof

The amended set of claims is based on claims 1 to 13 as originally filed.

The new features of amended claim 1 find their basic disclosure in paragraphs [0028] and [0030] of the description and can also be derived from Figures 4 to 6 and the respective parts of the description corresponding thereto.

The new features of amended independent claims 6, 7 and 12 can also be taken from these parts of the application documents as originally filed.

Therefore, the combination of features of the amended set of claims is sufficiently supported by the disclosure of the application documents as originally filed. An unallowable broadening of the scope of the application can thus be excluded, the amended set of claims is therefore admissible.

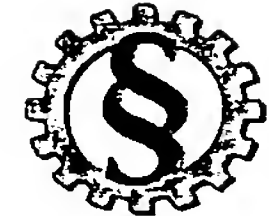
2. Patentability

Document **D2** (US 3,784,893), that has been considered to represent closest prior art for the subject-matter of independent claim 1 of the present invention, discloses a high voltage shutdown protection circuit with bias arrangement to decrease the voltage shutdown point with increasing load.

However, amended claim 1 of the present invention differs from the teaching of document **D2** in that

“the voltage generator device is capable to attain a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein, if an output current exceeds a first value of current, the output voltage is reduced, or, if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion is intermittently performed.”

Therefore, the subject-matter of amended claim 1 is novel against the art known from **D2**.



Further, document **D3** (EP 1 079 496 A2), that has been considered to represent closest prior art for the subject-matter of independent claim 12 of the present invention, discloses an abnormality detection apparatus for a power supply unit.

However, the subject-matter of amended claim 12 of the present invention differs from the teaching of document **D3** in that

„the voltage generator device attains a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein, if an output current exceeds a first value of current, the output voltage is reduced, or, if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion is intermittently performed.“

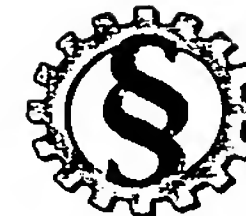
Therefore, the subject-matter of amended claim 12 is novel against the art known from **D3**.

In addition, the subject-matter of amended claim 1 of the present application differs from the teaching known from **D3** in the same features. Therefore, the subject-matter of amended claim 1 is also novel against the art known from **D3**.

Summarizing, the combination of features of the independent claims cannot be derived from the respective prior art documents **D2** or **D3** and is therefore novel against prior art.

Moreover, further cited document **D1** (EP 0 483 744 A2) that discloses a current detection circuit of a power semiconductor device and a power converter using the circuit, does neither disclose the above-mentioned features of the present invention, nor provide any hint for the skilled person to arrive at a solution for the initiating problem of the present invention, i.e. to attain a voltage compensation for being able to appropriately control the driving of necessary electric loads without occurrence of vehicle failures such as resetting of various settings of various loads retained during running of a vehicle due to a drop in battery voltage during restarting the vehicle after an idle stop situation.

Summarizing, none of the cited references provides any hint that, due to the inventive voltage generator device, even in case of overcurrent a voltage



compensation can be attained for a time of starting the engine, thus making it possible to prevent vehicle failures which may occur without such compensation.

Further, the cited references do also not provide a hint that, due to the inventive voltage generator device of the present invention it is further possible to maintain a predetermined output voltage even in case of appearing overvoltage because, if overvoltage occurs, a switching operation of the voltage generating portion is intermittently performed, thus being able to attain voltage compensation for a time of starting the engine.

The claimed combination of features of the amended set of claims can, therefore, neither be derived from the respective prior art documents if taken alone, nor from a synopsis of the teachings contained therein.

Thus, in absence of examples from the prior art that could render the subject-matter of the present invention obvious, the present application is based on an inventive step.

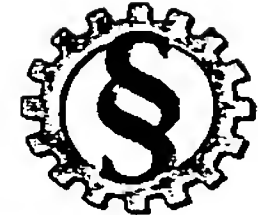
3. Unity of the invention

As regards the objections concerning unity of the invention, reference is made to Rule 13 of the PCT Regulations.

There, it is stated that an international application shall relate to one invention only or to a group of inventions so linked as to form a single general inventive concept (c.f. Rule 13.1).

As it is further stated, a group of inventions fulfills the requirement of unity of invention only when there is a technical relationship among those inventions involving one or more of the same or corresponding special technical features (c.f. Rule 13.2), wherein the expression "*special technical features*" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

Referring to the present invention, the special technical feature which forms the required technical relationship among the first and second invention (i.e. the voltage



generating device and the motor vehicle) is the voltage generating device that is capable to attain voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop.

Therefore, the generating device defines the device, whereas the vehicle defines the apparatus using the claimed device. Thus, the respective "inventions" are linked with each other.

Hence, the invention fulfills the requirements of PCT as regards unity of invention.

4. Formalities

Documents **D1 to D3** as cited by the International Searching Authority are now briefly discussed on new pages **3a and 3b** of the introductory part of the description.

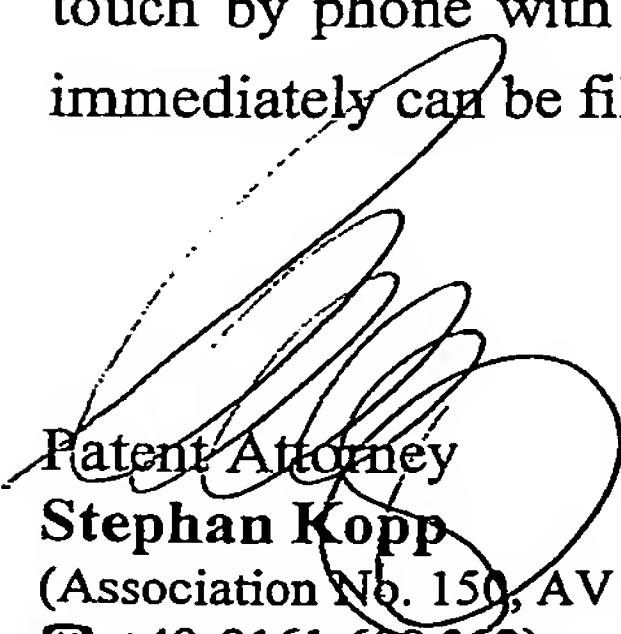
In view of the afore discussed facts and in view of having fulfilled all formal requirements according to PCT, it is now respectfully requested to establish a positive IPRP.

In case there should still remain basic objections to patentability of the subject-matter claimed, a

Hearing

according to **Art. 34(2)(a) PCT** and **Rule 66.6 PCT** is herewith respectfully requested. In order to agree upon a mutually convenient date, the Examiner is asked to contact the undersigning attorney.

If only minor amendments are considered to be necessary, it is requested to also get in touch by phone with the attorney who undersigned this petition, so that amended papers immediately can be filed in order to expedite the procedure.


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Enclosures:

- amended set of claims 1 to 13 (work sheet and fair copy);
- new description pages 3, 3a, 3b and 3c;

fair copy

(amended) Claims

1. A voltage generator device characterized by comprising:
a voltage generating portion (11) that receives an input voltage and generates a target voltage;
an observing portion (12) that observes an operating condition of the voltage generating portion (11); and
a control portion (16) which causes the voltage generating portion (11) to maintain a voltage generating operation even if the operating condition observed by the observing portion (12) is within a first region that is apart from a normal region, and which causes the voltage generating portion (11) to stop the voltage generating operation if the operating condition observed is within a second region that is further apart from the normal region than the first region is, wherein
the voltage generator device (6) is capable to attain a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein,
if an output current exceeds a first value of current, the output voltage is reduced,
or,
if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion (11) is intermittently performed.
2. The voltage generator device according to claim 1, wherein the operating condition is within the first region if a current through the voltage generating portion (11) is greater than a first value of current and is less than or equal to a second value of current, and the operating condition is within the second region if the current through the voltage generating portion (11) is greater than the second value of current.

3. The voltage generator device according to claim 2, wherein the control portion (16) reduces a target value of voltage output by the voltage generating portion (11) if a value of current through the voltage generating portion (11) increases provided that the operating condition is within the first region.
4. The voltage generator device according to claim 1, wherein the operating condition is within the first region if a voltage output by the voltage generating portion (11) is greater than a first value of voltage and is less than or equal to a second value of voltage, and the operating condition is within the second region if the voltage output by the voltage generating portion (11) is greater than the second value of voltage.
5. The voltage generator device according to claim 4,
wherein the observing portion (12) includes a voltage detecting circuit (14) that detects the first value of voltage, and an overvoltage detecting circuit (15) that detects the second value of voltage, and
wherein the control portion (16) performs on the voltage generating portion (11) a feedback control of setting an output of the voltage generating portion (11) at the target voltage in accordance with an output of the voltage detecting circuit (14), and stops the feedback control in accordance with an output of the overvoltage detecting circuit (15) and prohibits the voltage generating portion (11) from performing the voltage generating operation.
6. A motor vehicle characterized by comprising:
an electricity storage means (1);
a voltage generator device (6) that compensates for a fall of an output voltage of the electricity storage means (1); and

an automatic engine stop control means (5) that automatically controls stopping and starting of an engine,

wherein the voltage generator device (6) includes a voltage generating portion (11) that receives an input voltage and generates a target voltage, an observing portion (12) that observes an operating condition of the voltage generating portion (11), and a control portion (16) which causes the voltage generating portion (11) to maintain a voltage generating operation even if the operating condition observed by the observing portion (12) is within a first region that is apart from a normal region, and which causes the voltage generating portion (11) to stop the voltage generating operation if the operating condition observed is within a second region that is further apart from the normal region than the first region is, and

wherein the automatic engine stop control means (5) prohibits an automatic stop of the engine if it is detected that the operating condition is within the first region, and wherein

the voltage generator device (6) is capable to attain a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein,

if an output current exceeds a first value of current, the output voltage is reduced,

or,

if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion (11) is intermittently performed.

7. A control method for a voltage generator device (6) that includes a voltage generating portion (11) that receives an input voltage and generates a target voltage, characterized by comprising the steps of:
observing an operating condition of the voltage generating portion (11) and
causing the voltage generating portion (11) to maintain a voltage generating

operation even if the operating condition is within a first region that is apart from a normal region; and
causing the voltage generating portion (11) to stop the voltage generating operation if the operating condition observed is within a second region that is further apart from the normal region than the first region is, wherein the voltage generator device (6) attains a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein,
if an output current exceeds a first value of current, the output voltage is reduced,
or,
if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion (11) is intermittently performed.

8. The control method for the voltage generator device according to claim 7, wherein the operating condition is within the first region if a current through the voltage generating portion (11) is greater than a first value of current and is less than or equal to a second value of current, and the operating condition is within the second region if the current through the voltage generating portion (11) is greater than the second value of current.
9. The control method for the voltage generator device according to claim 8, wherein a target value of voltage output by the voltage generating portion (11) is reduced if a value of current through the voltage generating portion (11) increases provided that the operating condition is within the first region.
10. The control method for the voltage generator device according to claim 7, wherein the operating condition is within the first region if a voltage output by the voltage generating portion (11) is greater than a first value of voltage and is less than or equal to a second value of voltage, and the operating

condition is within the second region if the voltage output by the voltage generating portion (11) is greater than the second value of voltage.

11. The control method for the voltage generator device according to claim 10, wherein the voltage generator device (6) includes a voltage detecting circuit (14) that detects the first value of voltage, and an overvoltage detecting circuit (15) that detects the second value of voltage, and wherein the control method further comprises the step of performing on the voltage generating portion (11) a feedback control of setting an output of the voltage generating portion (11) at the target voltage in accordance with an output of the voltage detecting circuit (14), and the step of stopping the feedback control in accordance with an output of the overvoltage detecting circuit (15) and prohibiting the voltage generating portion (11) from performing an operation.
12. A control method for a motor vehicle that includes a voltage generator device that compensates for a change in an output voltage of an electricity storage means, characterized by comprising the steps of:
observing an operating condition of the voltage generator device (6) and causing the voltage generator device (6) to maintain a voltage generating operation even if the operating condition is within a first region that is apart from a normal region;
controlling stopping and starting of an engine in accordance with a state of the motor vehicle if the operating condition is within the normal region; and prohibiting an automatic stop of the engine if it is detected that the operating condition is within the first region, wherein
the voltage generator device (6) attains a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein,

if an output current exceeds a first value of current, the output voltage is reduced,

or,

if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion (11) is intermittently performed.

13. A computer-readable recording medium in which a program for causing a computer to execute the control method for the voltage generator device according to anyone of claims 7 to 11 or the control method for the motor vehicle according to claim 12 is recorded.

(amended) Claims

1. A voltage generator device characterized by comprising:
a voltage generating portion (11) that receives an input voltage and generates a target voltage;
an observing portion (12) that observes an operating condition of the voltage generating portion (11); and
a control portion (16) which causes the voltage generating portion (11) to maintain a voltage generating operation even if the operating condition observed by the observing portion (12) is within a first region that is apart from a normal region, and which causes the voltage generating portion (11) to stop the voltage generating operation if the operating condition observed is within a second region that is further apart from the normal region than the first region is, wherein
the voltage generator device (6) is capable to attain a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein,
if an output current exceeds a first value of current, the output voltage is reduced,
or,
if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion (11) is intermittently performed.
2. The voltage generator device according to claim 1, wherein the operating condition is within the first region if a current through the voltage generating portion (11) is greater than a first value of current and is less than or equal to a second value of current, and the operating condition is within the second region if the current through the voltage generating portion (11) is greater than the second value of current.

3. The voltage generator device according to claim 2, wherein the control portion (16) reduces a target value of voltage output by the voltage generating portion (11) if a value of current through the voltage generating portion (11) increases provided that the operating condition is within the first region.
4. The voltage generator device according to claim 1, wherein the operating condition is within the first region if a voltage output by the voltage generating portion (11) is greater than a first value of voltage and is less than or equal to a second value of voltage, and the operating condition is within the second region if the voltage output by the voltage generating portion (11) is greater than the second value of voltage.
5. The voltage generator device according to claim 4,
wherein the observing portion (12) includes a voltage detecting circuit (14) that detects the first value of voltage, and an overvoltage detecting circuit (15) that detects the second value of voltage, and
wherein the control portion (16) performs on the voltage generating portion (11) a feedback control of setting an output of the voltage generating portion (11) at the target voltage in accordance with an output of the voltage detecting circuit (14), and stops the feedback control in accordance with an output of the overvoltage detecting circuit (15) and prohibits the voltage generating portion (11) from performing the voltage generating operation.
6. A motor vehicle characterized by comprising:
an electricity storage means (1);
a voltage generator device (6) that compensates for a fall of an output voltage of the electricity storage means (1); and

an automatic engine stop control means (5) that automatically controls stopping and starting of an engine,

wherein the voltage generator device (6) includes a voltage generating portion (11) that receives an input voltage and generates a target voltage, an observing portion (12) that observes an operating condition of the voltage generating portion (11), and a control portion (16) which causes the voltage generating portion (11) to maintain a voltage generating operation even if the operating condition observed by the observing portion (12) is within a first region that is apart from a normal region, and which causes the voltage generating portion (11) to stop the voltage generating operation if the operating condition observed is within a second region that is further apart from the normal region than the first region is, and

wherein the automatic engine stop control means (5) prohibits an automatic stop of the engine if it is detected that the operating condition is within the first region, and wherein

the voltage generator device (6) is capable to attain a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein,

if an output current exceeds a first value of current, the output voltage is reduced,

or,

if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion (11) is intermittently performed.

7. A control method for a voltage generator device (6) that includes a voltage generating portion (11) that receives an input voltage and generates a target voltage, characterized by comprising the steps of:
observing an operating condition of the voltage generating portion (11) and
causing the voltage generating portion (11) to maintain a voltage generating

operation even if the operating condition is within a first region that is apart from a normal region; and

causing the voltage generating portion (11) to stop the voltage generating operation if the operating condition observed is within a second region that is further apart from the normal region than the first region is, wherein

the voltage generator device (6) attains a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein,

if an output current exceeds a first value of current, the output voltage is reduced,

or,

if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion (11) is intermittently performed.

8. The control method for the voltage generator device according to claim 7, wherein the operating condition is within the first region if a current through the voltage generating portion (11) is greater than a first value of current and is less than or equal to a second value of current, and the operating condition is within the second region if the current through the voltage generating portion (11) is greater than the second value of current.
9. The control method for the voltage generator device according to claim 8, wherein a target value of voltage output by the voltage generating portion (11) is reduced if a value of current through the voltage generating portion (11) increases provided that the operating condition is within the first region.
10. The control method for the voltage generator device according to claim 7, wherein the operating condition is within the first region if a voltage output by the voltage generating portion (11) is greater than a first value of voltage and is less than or equal to a second value of voltage, and the operating

condition is within the second region if the voltage output by the voltage generating portion (11) is greater than the second value of voltage.

11. The control method for the voltage generator device according to claim 10, wherein the voltage generator device (6) includes a voltage detecting circuit (14) that detects the first value of voltage, and an overvoltage detecting circuit (15) that detects the second value of voltage, and wherein the control method further comprises the step of performing on the voltage generating portion (11) a feedback control of setting an output of the voltage generating portion (11) at the target voltage in accordance with an output of the voltage detecting circuit (14), and the step of stopping the feedback control in accordance with an output of the overvoltage detecting circuit (15) and prohibiting the voltage generating portion (11) from performing an operation.
12. A control method for a motor vehicle that includes a voltage generator device that compensates for a change in an output voltage of an electricity storage means, characterized by comprising the steps of:
observing an operating condition of the voltage generator device (6) and causing the voltage generator device (6) to maintain a voltage generating operation even if the operating condition is within a first region that is apart from a normal region;
controlling stopping and starting of an engine in accordance with a state of the motor vehicle if the operating condition is within the normal region; and prohibiting an automatic stop of the engine if it is detected that the operating condition is within the first region, wherein
the voltage generator device (6) attains a voltage compensation by raising an output voltage when a battery voltage decreases at the time of restart of an engine after an idle stop, wherein,

if an output current exceeds a first value of current, the output voltage is reduced,

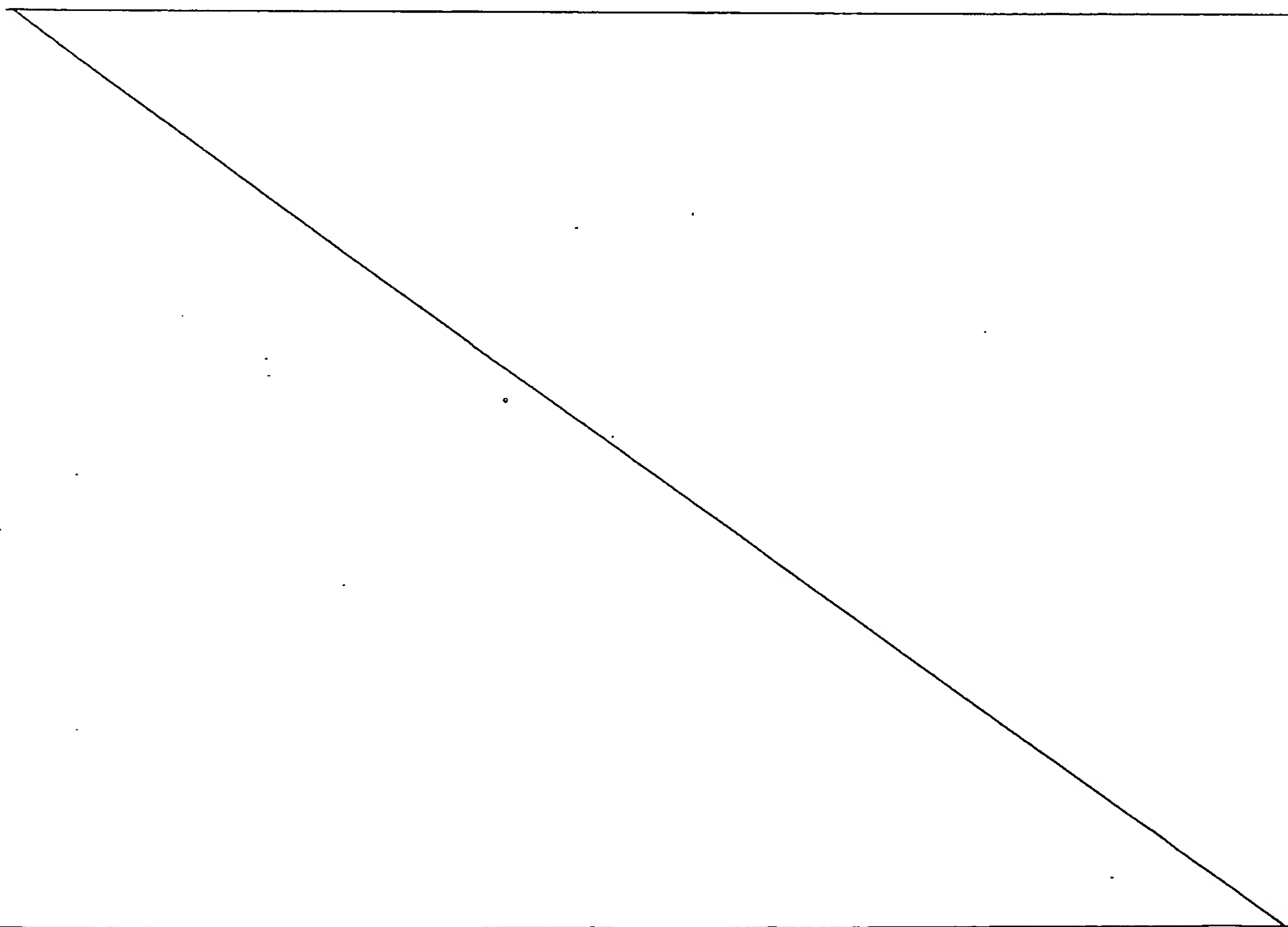
or,

if the output voltage exceeds a first value of voltage, a switching operation of the voltage generating portion (11) is intermittently performed.

13. A computer-readable recording medium in which a program for causing a computer to execute the control method for the voltage generator device according to anyone of claims 7 to 11 or the control method for the motor vehicle according to claim 12 is recorded.

the output voltage exceeds, for some cause, a target voltage (e.g., 12 V) of a voltage raising operation, and reaches an overvoltage prohibition threshold value (e.g., 16 V) that is close to the withstanding voltage of the electric load. In that case, an overvoltage stop output is output so as to stop the operation of the voltage generator device. Therefore, the input voltage is directly output. With regard to FIG. 11, it is to be noted that the output voltage is slightly lower than the input voltage due to the internal resistance of the voltage generator device.

[0011] Thus, since an ordinary voltage generator device, such as a DC/DC converter or the like, is designed taking a long-time continuous operation into consideration, the operation thereof is generally stopped, for example, for protection of an element or device, if an abnormality is detected. If such a control is applied to a voltage generator device that compensates for a voltage fall at the time of start of the engine after an idle stop, the problem of being unable to appropriately control the driving of a necessary electric load occurs also when the engine of a vehicle having a trouble is started in order to transport the vehicle to a repair shop.



Document EP 0 483 744 A2 discloses a current detection circuit of a power semiconductor device and a power converter using the circuit, wherein different detection levels of a load current can be detected. These detection levels are an overcurrent control level and/or a constant current control level. Said constant
5 current control level can be a constant current value associated with chopper control or a value which judges an overload when a chopper control current exceeds a predetermined current level beyond a predetermined number of times. Said overcurrent control level can be a value corresponding to short-circuit-protection.

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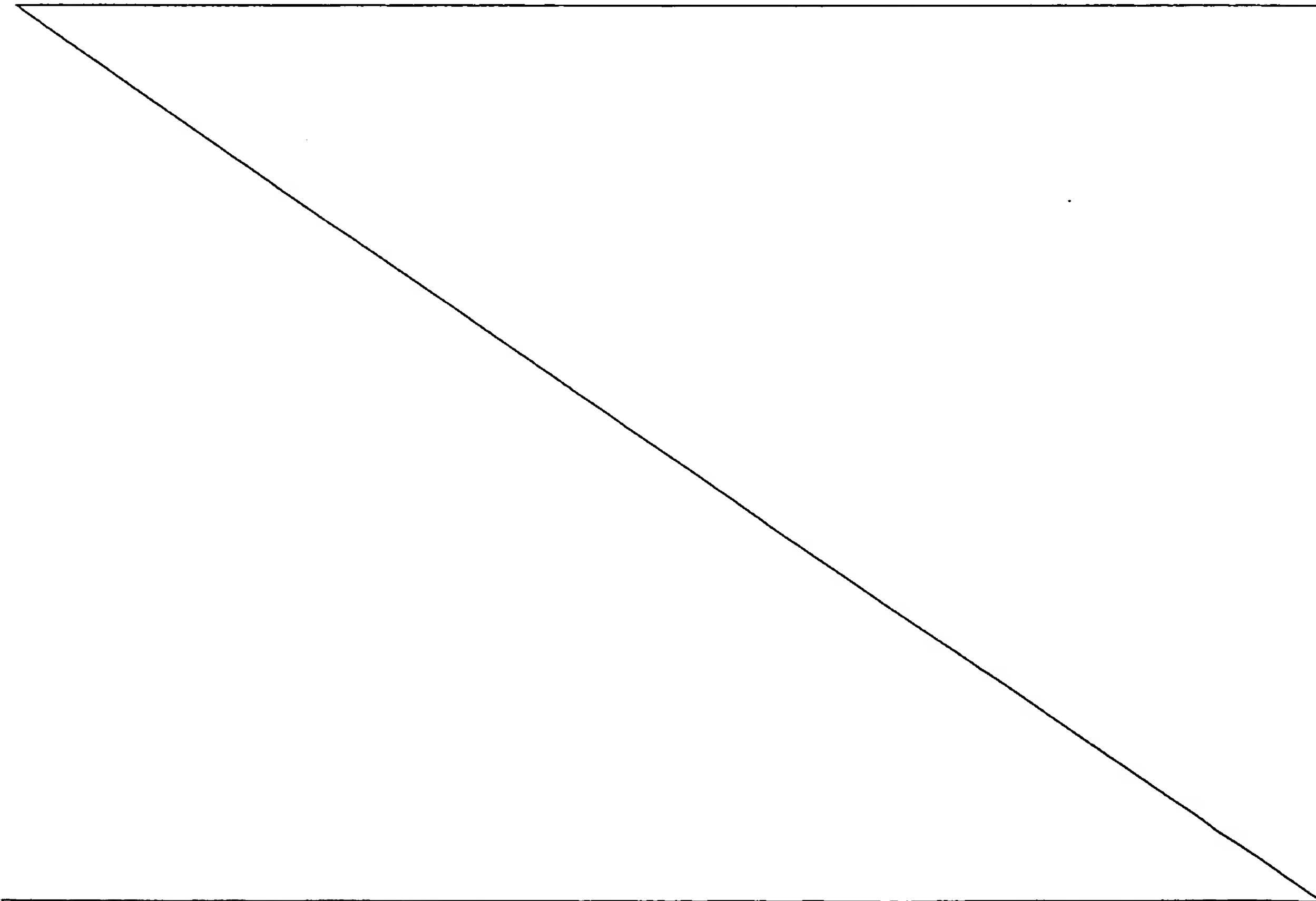
Further, a control circuit controls power semiconductor devices by decreasing a control voltage in a plurality of steps to zero in the case where an overcurrent detecting circuit outputs a detection signal corresponding to an overcurrent control level.

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Further, document EP 1 079 496 A2 discloses an abnormality detection apparatus for a power supply circuit associated with an internal combustion engine that detects an abnormality that may occur in a power supply circuit, and controls the automatic stop and the automatic start of the engine based on the state of the
20 power supply circuit. The state of charge/discharge of a battery determined based on the electric potential of a terminal located between the battery and a generator-motor or a load is compared with the current through the battery detected by an ammeter. If there is a contradiction therebetween, it is determined that an abnormality has occurred somewhere in the power supply circuit including the
25 battery. When it is determined that the power supply circuit has an abnormality, the apparatus performs such a control as to prevent the automatic stop/start control in which the engine is automatically stopped if a predetermined condition is met, and in which the engine is automatically restarted when the condition is unmet after being met.

Still further document US 3,784,893 discloses a high voltage shutdown protection circuit with bias arrangement to decrease the voltage shutdown point with increasing load. There, a current and voltage regulated DC to DC converter is designed with protection features to permit its operation in parallel with like DC to
5 DC converters. The features are designed to assure shutdown protection against overcurrent and overvoltage conditions and to assure that each converter will contribute a current to the common load. The protection features include a selective high voltage shutdown to shut down only the converter causing an overvoltage and an overcurrent protection circuit to supersede the normal current
10 regulation in response to a fault condition. A reverse current shutdown circuit protects the common load from faults and short circuits internal to the converter circuit. These protection features permit the converters to operate in parallel without shutting down the entire system should an individual converter malfunction.

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SUMMARY OF THE INVENTION

[0012] The invention has been accomplished in order to solve the aforementioned problem. It is an object of the invention to provide a voltage generator device that prevents occurrence of a problem regarding an electric load by maintaining a voltage raising operation as much as possible and provide a motor vehicle equipped with the voltage generator device.

[0013] It is another object of the invention to provide control methods for the voltage generator device and the motor vehicle, and a computer-readable recording medium storing programs for causing a computer to execute the control methods.

[0014] The voltage generator device of the invention includes a voltage generating portion that receives an input voltage and generates a target voltage, an observing portion that observes an operating condition of the voltage generating portion, and a control portion. The control portion causes the voltage generating portion to maintain the